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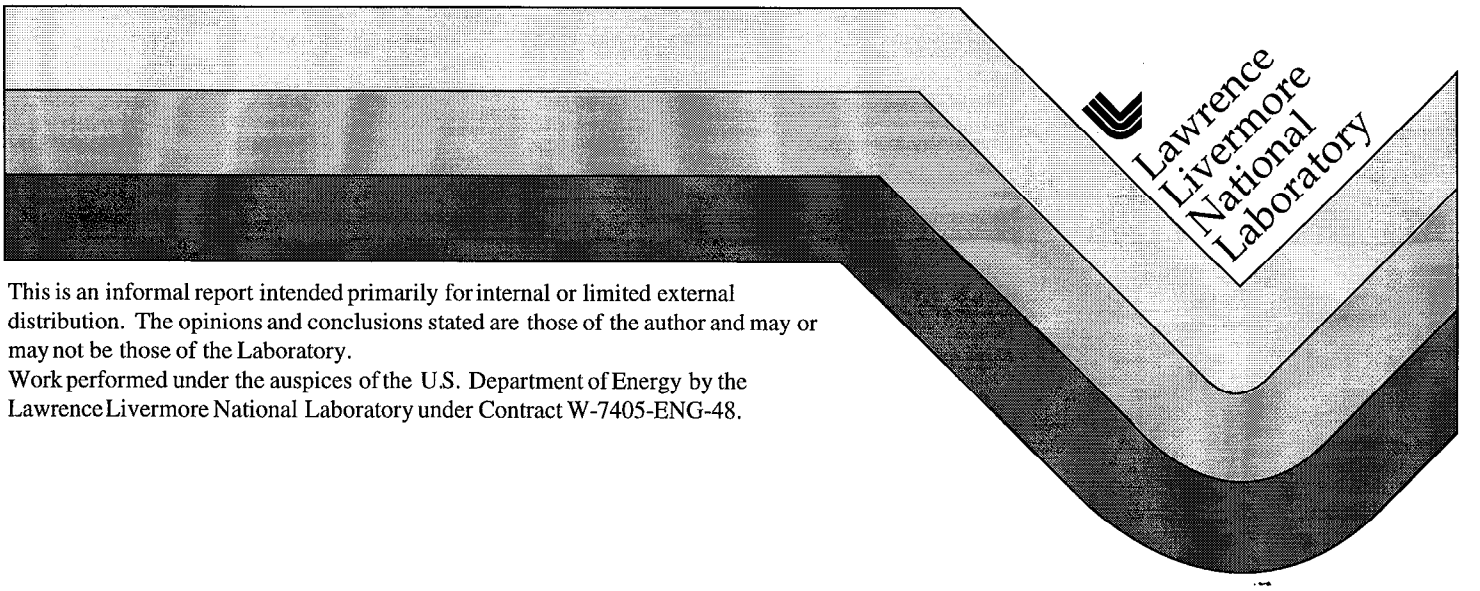
# National Ignition Facility Quality Assurance Program Plan Revision 2

C. Robert Wolfe

**June 1998**

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# NIF Project Quality Assurance Program Plan

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# NIF Project Quality Assurance Program Plan

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# Contents

# NIF Quality Assurance Policy

*NIF Project activities will be conducted in a manner consistent with the guidance and direction of the DOE Order on Quality Assurance (414.1), the LLNL QA Program, and the Laser Directorate QA Plan. Quality assurance criteria will be applied in a graded manner to achieve a balance between the rigor of application of QA measures and the scale, cost, and complexity of the work involved.*

*Accountability for quality is everyone's, extending from the Project Manager through established lines of authority to all Project personnel, who are responsible for the requisite quality of their own work.*

*The NIF QA Program will be implemented by personnel conducting their activities to meet requirements and expectations, according to established plans and procedures that reflect the way business is to be conducted on the Project.*

Jeffrey A. Paisner
NIF Laboratory Project Manager

# INTRODUCTION

The National Ignition Facility (NIF) is a key constituent of the Department of Energy's Stockpile Stewardship Program. The NIF will use inertial confinement fusion (ICF) to produce ignition and energy gain in ICF targets, and will perform weapons physics and high-energy-density experiments in support of national security and civilian objectives.

The NIF Project is a national facility involving the collaboration of several DOE laboratories and subcontractors, including Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and the University of Rochester Laboratory for Laser Energetics (UR/LLE).

The primary mission of the NIF Project is the construction and start-up operation of laser-based facilities that will demonstrate fusion ignition in the laboratory to provide nuclear-weapons-related physics data, and secondarily, to propagate fusion burn aimed at developing a potential source of civilian energy.

To support the accomplishment of this very important mission, the LLNL Laser Directorate created the NIF Laboratory Project Office to organize and bring about the Project. The NIF Laboratory Project Office has established this Quality Assurance Program to ensure its success. This QAPP defines and describes the program—the management system—for specifying, achieving, and assuring the quality of all NIF Project work consistent with the policies of the Lawrence Livermore National Laboratory and the Laser Directorate. This issue of the Quality Assurance Program Plan (QAPP) completes the requirements for the conduct of Title II design, construction, procurement, and Title III engineering. No retrofit of completed work or subcontracts is intended to result from this revision, unless specifically identified at the time of issue.

## LLNL Quality Assurance Policy

All research, development, and operational activities will be conducted in accordance with our customers' needs and expectations, and with a commitment to excellence, innovation, and continuous quality improvement.

The LLNL QA Program provides institutional guidance and direction for:

- Complying with applicable requirements.
- Using a graded approach to optimize the benefits of the program.
- Emphasizing continuous performance improvement.
- Using periodic independent and self assessment of quality.

**Laser Programs Directorate Quality Assurance Policy**

All work conducted for the Department of Energy will be conducted in observance of the LLNL policy on quality assurance and the requirements of applicable DOE Orders (for QA, 414.1, formerly 5700.6C). The Laser Directorate is committed to identifying and correcting deficiencies associated with its program activities.

The Laser Directorate will promote the acquisition of scientific and technical knowledge while assuring management accountability, sufficient controls, and appropriate documentation. Each person shall be trained and qualified for assigned responsibilities, maintain a quality awareness, observe QA plan and procedure requirements, and be proactive in improving work practices.

**Purpose and Scope of the QA Program Plan**

This QAPP delineates and defines the QA requirements governing quality-affecting activities of the NIF Project team participants, and its subcontractors. It also describes the program implemented by the Project to comply with these requirements. This program is applicable to Project functions, such as management, design, procurement, fabrication, handling, shipping, storage, construction, installation, inspection, testing, and start-up of all structures, systems, and components for the NIF Project.

This QA Plan incorporates and supplements applicable QA Program requirements of DOE Order 414.1 and LLNL QA Plan M-078, and the Laser Directorate QA Plan L-18724.

Through the issuance of this QAPP document, the NIF Laboratory Project Manager has established the following:

- The responsibility and authority for developing and implementing a quality program for the Project.
- The requirement that the Project's quality program meet applicable federal codes, standards, and regulations.
- The requirement that effective QA activities be implemented by the Project and its subcontractors, commensurate with importance of the work involved.
- The requirement that work be evaluated, issues adverse to quality be identified, and that effective corrective actions be taken when necessary, by responsible personnel.

This QAPP is based on the following fundamental principles:

- Achievement of quality is a line responsibility wherein each employee and supervisor is accountable for the quality of work assigned to them.
- The NIF Project Quality Assurance Manager maintains an overview of the work to provide additional assurance that specified requirements are met. This is

accomplished through oversight activities, such as surveillance, audits, and other assessments.
- The degree of application of quality assurance criteria is dependent upon the magnitude of risk or hazard associated with the potential failure of the component, system or activity involved. This is accomplished through the use of graded assurance measures.
- A no-fault attitude is fostered by management to encourage the identification of nonconformances, so that processes can be improved to prevent the recurrence of problems.

The quality program implemented in this QAPP is expressed in the following hierarchy of documents:

- *DOE Order 414.1 (formerly 5700.6C), Quality Assurance*—establishes QA requirements for work performed by the Department of Energy and its contractors.
- *LLNL Quality Assurance Program* (QAP)—identifies QA requirements applicable to all Laboratory activities (document number M-078).
- *LLNL Laser Programs Directorate QA Plan* (DQAP)—provides guidance and requirements applicable to all work performed within and for the Laser Directorate (document number L-19798-1).
- *NIF QA Program Plan* (QAPP)—defines the NIF Laboratory Project Manager's policy and direction for implementing a quality assurance program; interprets the provisions of DOE Order 414.1, the LLNL QAP, and the Laser Directorate DQAP, and applies them to NIF Project activities, adding specificity to the requirements; and broadly describes how the NIF Project conducts its business.
- Ancillary or Subcontractor QA Plans—establish QA requirements for an individual organization within the Project or a subcontractor doing business with the Project. Such plans address the management of activities limited to the organizations' assignments.
- Implementing Procedures and Instructions—provide direction and specific instructions for workers to accomplish tasks within the framework of a management program.
  - — Project-wide procedures established in the NIF Project Control Manual (PCM) flowing down from this QAPP are usually generic, with widespread application across NIF Project organizations.
  - — Project organization procedures resulting from this QAPP or the PCM are specific to activities involved in the organizations' work. Subcontractor procedures generated to cover their workscope must also comply with this hierarchy of documents.

## Arrangement of This Document

The basic requirements of this QAPP are presented in three categories that include the ten QA criteria established for a total management system described in DOE Order 414.1:

- Management
  - 1 – Program
  - 2 – Personnel Training and Qualification
  - 3 – Quality Improvement
  - 4 – Documents and Records
- Performance
  - 5 – Work Processes
  - 6 – Design
  - 7 – Procurement
  - 8 – Inspection and Acceptance Testing
- Assessment
  - 9 – Management Assessment
  - 10 – Independent Assessment

Section 1.0 of this document provides a narrative description of the QA Program structure and the roles and responsibilities of individuals in the NIF Project organization who implement the program.

In Sections 2.0 through 10.0, the remaining nine QA criteria of the three major categories are briefly stated, then followed by a description of the Project's methodology for complying with them, including a reference to subtier implementation documents, such as procedures or work instructions.

Appendix A presents the Project Organization Chart. Appendix B provides a Glossary of Acronyms and Common Terms. Appendix C summarizes the ten QA criteria and the corresponding documents established by the NIF Project to implement the QA requirements. Appendix C provides a useful "at-a-glance" reference for identifying subtier Project documents that implement this QA Program. Appendix D is a compilation of "Lessons Learned," for the Project.

**Revision history**

| Document # | Date | Description/reason for change |
|---|---|---|
| NIF-LLNL-93-044 | 1/94 | initial release |
| NIF-LLNL-95-499 | 9/95 | revision for Title I |
| NIF-0000618 | 9/96 | major revision for Title II, implementing document summarized in appendix |
| NIF-0000618-OA | 6/98 | revised for Title II and III |

# MANAGEMENT

## 1.0 Program

Criterion 1 of DOE Order 414.1, Quality Assurance, requires the following:

- Develop, implement, and maintain a written QA program, applied with rigor commensurate with importance of the work.
- Describe the organization responsible for managing, performing, and assessing the work.
- Describe the management system, including cost and schedule control.

### 1.1 QA Program Structure—the Graded Approach

This QAPP complies with the requirements of DOE Order 414.1, LLNL QAP M-078, and Laser Programs DQAP L-18724. It establishes specific responsibilities for implementing the NIF Project's quality program in a graded manner, according to three quality assurance levels (Q-Levels) in the following table:

| Q-Level | Degree of quality assurance activities |
|---|---|
| 1 | Full formal QA documentation, verification, and audit activities for the work involved. |
| 2 | Formal QA documentation, verification, and audit for some aspects of the work. |
| 3 | Documentation and verification that meets national consensus standards specified for the work. |

**Q-Level 1**—Project structures, systems, components and activities whose failure could cause undue risk to the health and safety of employees or the public; they could have significant potential for damage to the environment; or they could cause an unacceptable program interruption, monetary loss, or schedule delay. The consequences of failure are unacceptable, and the probability of failure is significant unknown.

Structures, systems, components, and activities classified as Q-Level 1 shall adhere to the highest level of QA requirements as established by the table above and described in this document.

**Q-Level 2**—Project structures, systems, components, and activities whose failure could risk health and safety of employees or have minor impact on the environment, or could degrade the performance or reliability of operations, data acquisition, or deliverables. The consequences of failure are severe but tolerable, and the probability of failure is moderate.

Structures, systems, components, and activities classified as Q-Level 2 shall, as a minimum, adhere to the augmented level of QA requirements as established by the table above and described in this document.

**Q-Level 3**—Project structures, systems, components, and activities whose failure would not result in any significant health, environment, or safety risk, or loss or impairment of data generation. The consequences of failure are negligible or acceptable, and/or the probability of failure is insignificant.

Structures, systems, components, and activities classified as Q-Level 3 shall, as a minimum, adhere to the lowest level of QA requirements as established by the table above and described in this document.

## 1.2 QA Program Application

The NIF Laboratory Project Manager retains the responsibility for implementing this QAPP, in which line managers, supervisors, and employees are responsible for ensuring that quality and performance objectives are effectively and efficiently achieved. The QAPP describes the way the NIF Project does business, and applies, according to the graded approach described in section 1.1, to all activities described by the Project Work Breakdown Structure (WBS)

This QA Program is implemented through the documents that are summarized in Appendix C. Key among these documents is the *NIF Project Management System Description (NIF-0002216)* which summarizes the management organization and demonstrates compliance with DOE Order 430.1 (Life Cycle Assests Management, LCAM). All Project personnel receive an orientation in the principles and provisions of the Project QA Program—the *project management system.* Personnel performing quality-affecting or verification activities receive additional training as described in Section 2.0.

The Q-Levels are "confidence levels" or degrees of assurance, rather than "graduated levels of quality" and are applied as appropriate to all structures, systems, and components, and the activities associated with them. The extent of controls applied for each Q-Level is based on fundamental considerations, such as the consequences of failure, complexity of design and fabrication, degree to which function can be demonstrated by test or inspection, past performance, impact on schedule, and economic considerations.

The responsible System Engineers (the Project's technical authority) are accountable for performing evaluations to determine or revise the Q-Levels appropriate for the

structures, systems, and components within their purview, according to NIF Procedure 1.6, Assignment of Quality Assurance Levels. They are also accountable for documenting the necessary controls intended for ensuring the quality of the work.

## 1.3 Organization

The organizational units comprising the Project are illustrated in Appendix A, NIF Project Organization. The organization described herein includes personnel responsible for achieving quality and those responsible for verifying its achievement, normally those who did not perform the activities. Verification personnel, whether in the line or organizationally independent, have sufficient freedom, authority, access, and responsibility to do the following:

- Identify quality problems, deficiencies in hardware and documentation, and noncompliance with performance objectives.
- Initiate, recommend, or provide solutions through designated channels.
- Verify implementation of the solutions.
- Assure that deficient work is stopped or is proceeding under controlled conditions until proper disposition of the unsatisfactory condition is accomplished.

The quality-related responsibilities for the management positions of the Project's organizational units depicted in Appendix A are briefly described in the paragraphs below. Where titles are used to designate responsibility, the named position has the authority to designate another qualified position within the organization to perform an assigned task. The incumbent, however, retains the responsibility (is accountable) for implementing the requirements.

Subtier organizations may be described in subtier or ancillary QA plans that deal with organization-specific activities. Otherwise, the Project organizations operate directly in accordance with this QAPP and the *Project Control Manual*, CD 027, which contains management system procedures that implement this QAPP. Section 5.1, *Procedures and Other Instructive Documents*, states the requirement that suppliers work according to Project approved procedures. Section 7.1, *Supplier Use of the NIF Project QA Program*, describes partial application of this QAPP to certain suppliers.

### 1.3.1 NIF Laboratory Project Manager

The Laboratory Project Manager reports to the Associate Director for Laser Programs, and interfaces with the NIF DOE Field Office. The Laboratory Project Manager has the overall responsibility and authority for the Project in accordance with the NIF Project Execution Plan, *CD 079*. To carry out this responsibility, the Laboratory Project Manager relies on the assistance of the Deputy Project Manager, and Project Scientist, the Senior Staff Engineer, the support of four National Laboratory Deputies, and the administrative and technical performance of a Project staff. The responsibilities for these management positions, including the senior managers of the project staff, are

provided in *NIF Management Descriptions (NIF-0000810 - OB).* The QA program responsibilities are summarized below.

The Project Manager's responsibilities include but are not limited to the following:

- Interfacing with the DOE on project management issues.
- Working with the Project staff to establish the technical, cost, and schedule baselines for the Project. Ensuring that the approved baselines are controlled through the Project change control process.
- Establishing and chairing the Level 3 Baseline Change Control Board.
- Establishing and implementing the QA Program for the NIF Project.
- Ensuring that Federal, State, and local regulations are carried out.
- Establishing, through appropriate contract language, the QA requirements for all Project subcontractors.
- Assessing Project work to ensure achievement of the Project mission, objectives, and quality requirements.

### 1.3.2 Deputy Project Managers

There are two categories of Deputies: 1) the Principal Deputy Project Manager, responsible for specific implementation areas, and 2) the Institutional Deputy Project Managers who represent the institutions participating in the NIF Project.

#### 1.3.2.1 Principal Deputy Project Manager

The Principal Deputy reports to the Laboratory Project Manager and has the following responsibilities:

- Acts for the Laboratory Project Manager in his/her absence.
- Provides liaison to the DOE HQ Director of Inertial Fusion and the NIF.
- Implements the design review process.
- Works with the Procurement Manager to develop procurement plans and strategies.

#### 1.3.2.2 Site Manager

The NIF Site Manager reports to the Laboratory Project Manager and is responsible for establishing and maintaining safe working conditions at the site and coordinating activities among the Construction Managers. The Site Manager has the following responsibilities:

- Control access to the site and administer the rules and regulations that must be adhered to by anyone working on the site. This includes an extensive set of safety and training requirements.
- Assign areas of the site to Construction Managers and approve any transfer of area responsibility between CMs.
- Anticipate and resolve space, equipment availability, personnel, and schedule conflicts while minimizing Project costs and achieving earliest performances of NIF operational objectives. Responsible for interface resolution between areas

and systems as described in the Site Management Plan. Conduct site coordination meetings (frequency based on level of work activity).
- Coordinate and interface with the Conventional Facilities Construction Manager, Special Equipment Construction Managers, Start-up and Operations Engineering Construction Manager, and the ICF/NIF Facility Manager.
- Concur on Construction Safety Program, Start-up/Operations Engineering and Special Equipment Construction Health and Safety Plan, Conventional Facilities Health and Safety Plan, and all other site specific health and safety plans.
- Project Lead on direct reporting chain for site accidents and near misses.

The Site Manager does not have line responsibility over the Associate Project Engineers or their Construction Managers. However, the individual Construction Managers for the Laser Bay, Target Area, Conventional Facilities, and Start-up and Operations Engineering are accountable to the Site Manager for conducting their activities within the ES&H rules and regulations on the site. For Facilities (e.g., OAB) turned over for Program operation, the ICF/NIF Facility Manager directly interfaces with the Site Manager on facility/equipment availability, personnel, and schedule coordination, and conflicts.

#### 1.3.2.3 Institutional Deputy Project Managers

Institutional Deputies representing each of the four laboratories involved (LLNL, LANL, SNL, UR/LLE) are responsible for directing their laboratories' technical participatory effort in support of the NIF, according to the Project Manager's requests and established NIF Project requirements. They have the following additional responsibilities:
- Ensures that his institutions QA requirements are consistent with the NIF QAPP.
- Implements the QAPP and lower tier QA/QC plans at his/her site.

### 1.3.3 Project Scientist

The NIF Project Scientist reports to the Project Manager and holds the primary technical position in the Project Office. The Project Scientist executes this responsibility by actions, such as the following:

- Establishing primary criteria and functional requirements for the Project technical baseline.
- Ensuring resolution of science and technology issues.
- Interfacing with the National ICF Program.
- Conducting reviews to assure the Project's technical performance.

### 1.3.4 Senior Staff Engineer

The NIF Senior Staff Engineer reports to the Project Manager and provides engineering consultation and liaison between participants. He/She assists in resolution of engineering issues across institutional boundaries. The Senior Staff Engineer

provides engineering liaison with NIF DOE Field Office. He/She executes these responsibility by actions, such as the following:

- Advising the Project Manager on engineering issues.
- Liaison to NIF Deputy Project Managers and the NIF DOE Field Office
- Preparer of NIF Quarterly and monthly Reports to DOE
- Approver of close-out of major Title I Review action items
- Member of Level 3 and 4 Change Control Boards
- Analyzing designs to assure their manufacturing feasibility.

### 1.3.5 Associate Project Engineers/Leaders

Three NIF Associate Project Engineers (APEs) and one Associate Project Leader (APL) report to the Laboratory Project Manager: APE for Special Equipment, APE for Conventional Facilities, APE for Start-up and Operations Engineering, and APL for Laser Materials and Optics Technology. These individuals are responsible for planning and acquisition and/or activation of structures, systems, and components that comprise the NIF. They are the line managers responsible for the technical direction of major areas (e.g. groupings of systems) assigned to them by the Project Manager. To carry out these responsibilities, the APEs/APL are assisted by Deputy APEs, System Engineers, and their staffs of discipline engineers and other technical personnel. Their responsibilities include but are not limited to the following:

- Developing design requirements to implement the Project's primary criteria and functional requirements for systems within their purview.
- Interfacing with the Systems Integration Manager to control design requirements and interfaces.
- Ensuring that the Q-level designation process is carried out and that QA Plan implementation occurs.
- Establishing the training and qualification requirements (see also Project Administrator)
- Directing the activities of System Engineers, technical personnel, and subcontractors in implementing the Project technical baseline.
- Designing, procuring, fabricating, installing, constructing, inspecting, and testing the Project structures, systems, and components within their purview.

### 1.3.6 System Engineers

NIF System Engineers report to their respective APE/APL, and are responsible for directing the technical staffs and management of the technical aspects of design, procurement, installation, and acceptance of their systems. They are the line managers who represent the technical authority for their assigned systems. These responsibilities include but are not limited to the following:

- Preparing System Design Requirements (SDRs), Subsystem Design Requirements (SSDRs), and Interface Control Documents (ICDs).
- Establishing interfaces with other Project systems.

- Designing the system or process and performing engineering analyses to support the system or process design.
- Performing Title III engineering.
- Assigning and revising Q-levels, establishing quality requirements, and implementing QC measures to assure that the systems meet specified quality requirements, including preparing QA/QC plans procedures where needed.
- Providing safety input to the Project's Environment, Safety, and Health (ES&H) documents.
- Estimating and scheduling the work involved in the design, procurement, installation, inspection, and testing of the system.

### 1.3.7 Systems Integration and Engineering Services Manager

The NIF Systems Integration and Engineering Services Manager reports to the Project Manager, and is responsible for ensuring an integrated systems approach to the design and construction of the NIF. He/she is responsible for activities such as the following:

- Coordinating design requirements and criteria for Project systems to assure proper flowdown from the primary criteria and functional requirements.
- Assessing overall Project risk and advising the Project Manager on risk management.
- Establishing interface controls to document key interfaces among Project systems, such as interference prevention and vibration-control budgeting.
- Evaluating NIF performance through operational analyses.
- Establishing a design service organization (electrical, electronic, and mechanical) to support the Project's special equipment system engineers.
- Establishing a configuration-control/data-management program for the Project and ensuring preparation of a Configuration Management Plan and implementing documents.
- Implementing a NIF computer-aided-design and -drafting system.
- Linking the engineering data management system with financial and procurement controls (Project and institutional) to establish production controls for special equipment systems.

### 1.3.8 Project Assurance Manager

The Project Assurance Manager reports to the Project Manager and is responsible for environmental, safety, health, quality, and security aspects of the Project. He/She interfaces with DOE on Assurance issues, and is responsible for activities such as the following:

- Evaluating environmental impacts of the Project, including NEPA documentation, permits, and monitoring.
- Performing and reporting safety analyses of Project construction and operation.
- Ensuring the establishment and implementation of an ES&H management plan and an ALARA program.

- Interfacing with DOE on ES&H and other issues.
- Ensuring the establishment and implementation of a Project quality program, including project controls and recordkeeping.
- Establishing and implementing a security plan.

### 1.3.9 Quality Assurance Manager

The Project QA Manager reports to the Project Manager through the Project Assurance Manager, and is responsible for developing and issuing this QAPP document. He/She is responsible for reviewing and concurring in management plans, subtier and ancillary QA plans, and implementing procedures. The QA Manager is responsible for activities such as the following:

- Advising management of quality achievements and recommending means of improving quality performance, so that line managers may relie on independent evaluation
- Developing a project management/quality assurance orientation program for Project personnel.
- Establishing generic project management/quality assurance procedures and instructions.
- Verifying the quality of work by independent audit, assessment or surveillance.
- Investigating quality issues.
- Furnishing quality assurance expertise to support Project assessments.

### 1.3.10 Project Control Function

The NIF Project Control Function reports to the Project Manager and is responsible for cost and schedule control and reporting for the Project. The Project Control Function is responsible for activities such as the following:

- Developing and maintaining the Project Summary Work Breakdown Structure and Dictionary.
- Coordinating development of the Project Execution Plan for issue by the Project Manager.
- Establishing and implementing a cost and schedule control and reporting system, including cost-account planning and documentation.
- Establishing and implementing baseline change controls, including the tracking and trending of effects of changes to Project baselines.
- Advising the Project Manager on cost, schedule, and financial matters.
- Interfacing with DOE and participating laboratories on the Project's financial matters.

### 1.3.11 Project Administrator

The NIF Project Administrator reports to the Project Manager and is responsible for managing the administrative personnel and support functions of the Project. The Project Administrator is responsible for activities such as the following:

- Managing Project documents and records; maintaining QA files.
- Implementing a Project action tracking system for the Project Office.
- Implement a personnel training tracking system for the Start-up/Operations Engineering Associate Project Engineer.
- Supervising the administrative staff and managing the administrative affairs of the Project.

### 1.3.12 Procurement Manager

The NIF Procurement Manager reports to the Project Manager and is responsible for all Project procurement and subcontract actions. The Procurement Manager is responsible for activities such as the following:

- Developing and maintaining a Procurement Plan and acquisition strategy, by interaction with the Project's senior managers; maintaining a qualified vendor base.
- Managing a staff of procurement specialists to place and manage procurements for the Project, including major subcontracts for architect-engineers, engineering service contractors, optics facilitization vendors, master task agreements, and a construction manager.
- Resolving procurement quality assurance issues regarding compliance with specifications, inspections, nonconformance reporting, etc.
- Advising the Project Manager on procurement issues and contractual matters.
- Interfacing with DOE and participating laboratories on procurement issues and contractual matters.

### 1.3.13 All NIF Project Personnel

Each individual in the NIF Project organization, whether matrixed, directly employed, or subcontracted by the Project, is responsible for receiving Project training specified by his/her manager, and is accountable for achieving quality in his/her own work.

All personnel are responsible for executing their work and ensuring that quality-affecting activities within their purview are performed in conformance with this QA Program Plan and the applicable approved plans and procedures, such as those cited in this QAPP (see summary in Appendix C).

## 1.4 Delegation of Responsibility for Quality

When responsibility for attaining quality is assigned to other Laboratory personnel, subcontract personnel, consultants, suppliers, or vendors, quality assurance requirements and work controls are documented in contracts, statements of work, task records, or similar documents. These documents include, as applicable, the assigned responsibilities, lines of communication, criteria defining acceptable work, and a listing of deliverables.

The individual or organization delegating the work retains the responsibility for establishing and implementing management controls to assure that the delegated work meets quality requirements.

### 1.5 Stop Work Authority

Each person has the authority and responsibility to stop his/her own work when continuation will produce or conceal results that are not in accordance with prescribed requirements. Each person has the responsibility to report such conditions to line management. Further, each person has the responsibility to advise others to stop work that is creating an unsafe condition, and to report that unsafe condition to the appropriate safety officer. The safety aspects of the stop work authority are discussed in detail in the *NIF Construction Safety Program (NIF-0001374).*

In all cases, stop work orders are issued and lifted according to *NIF Procedure 3.3, Stop Work Action.*

### 1.6 Cost and Schedule Control

Each person has the obligation to be cognizant of the financial and schedule significance of his/her work. When making decisions, managers consider the cost and schedule effects of alternatives, and are accountable for maintaining cost and schedule baselines, as well as the technical and quality elements of the Project. The balance of the cost and schedule with the technical and assurance (including ES&H) requirements is one of the principles of Integrated Safety Management.

Project cost estimates are prepared according to *NIF Procedures 1.2, Cost Estimating* and *1.9, Generation of Cost Account Plans.* Schedules for the work are prepared according to *NIF Procedure 1.3, Schedule Preparation, Statusing and Revision.*

## 2.0 Personnel Training and Qualifications

Criterion 2 of DOE Order 414.1 requires the following:

- Personnel shall be trained and qualified for their assigned work.
- Continuing training shall be provided to ensure proficiency.

The qualifications of NIF Project personnel who are assigned to manage, perform, or verify activities that affect quality are established and recorded according to *NIF Procedure 2.1, Personnel Qualification Approval and Records Retention.* Further, these personnel receive appropriate Project-specific orientation and training prior to performing assigned work. The training required is determined by organization managers in accordance with *NIF Procedure 2.2, Personnel Training and Qualification.*

Personnel who participate in independent QA Program assessments are qualified according to the requirements in *NIF Procedure 2.3, Qualification of QA Program Auditors.*

Training of subcontractor personnel is verified by examination of personnel qualification records, surveillance of work in progress, and assessment of output products through the testing and inspection activity discussed in Sections 7.0 and 8.0 of this QAPP.

# 3.0 Quality Improvement

Criterion 3 of DOE Order 414.1 requires that processes be implemented to:

- Detect and prevent quality problems to ensure improvement.
- Identify, control, and correct items and processes that do not meet requirements.
- Identify causes of problems to prevent their recurrence.
- Analyze quality results information to identify areas needing improvement.

## 3.1 Control of Nonconformances

Each person has the authority to identify conditions adverse to quality. He/She is responsible for reporting them to appropriate management by means of a Nonconformance Report (NCR), according to *NIF Procedure 3.2, Nonconformance Reporting,* or its approved subcontractor equivalent. Deficient conditions are investigated and dispositions are determined by the appropriate technical line authority. The nonconforming items can be repaired, reworked, accepted as is or rejected. A Materials Review Board may advises the line manager on the proper disposition.

Deficiencies identified by inspections, assessments, or other reviews of completed work are also reported on NCRs, which are periodically analyzed by the Project QA Manager for possible trends to identify opportunities for improvement.

## 3.2 Corrective Action

As part of the nonconformance control process, consideration is given to root causes and generic implications; corrective action is taken according to the methods established by the technical authority who dispositions the NCR. When necessary, further action may be taken to prevent recurrence of significant conditions adverse to quality. To maintain management visibility, significant issues are tracked according to the process described in *NIF Procedure 1.8, Project Action Tracking.*

### 3.3 Performance Measurement

Performance standards for individual activities are established in the drawings, specifications, procedures, and test instructions that govern the work. Information on compliance with individual-task quality performance requirements is collected and analyzed through the nonconformance/corrective action process described above. This process provides the feedback information necessary for NIF Project technical personnel to address problems commensurate with their Q-Level, degree of importance, and occurrence. This process is connected to the Title III Engineering and change control procedures. These are described in the *NIF Title III Engineering Plan* and in *NIF Procedure 6.6 Title III Change Control.*

## 4.0 Documents and Records

Criterion 4 of DOE Order 414.1 requires the following:

- Documents that describe processes, specify requirements, or establish designs shall be prepared, reviewed, controlled, and maintained.
- Records that provide evidence of quality shall be specified, reviewed, controlled, and maintained.

### 4.1 Technical Documents

Documents such as criteria, interface controls, drawings, calculations, computer codes, specifications, procedures, data sheets, vendor data, program plans, work instructions, etc., are either locally controlled by engineering organizations according to their internal procedures, or controlled at the Project Document Control Center (DCC) in accordance with *NIF Procedures 4.1, Document and Records Control and 4.2, Control of Project Correspondence.*

The user of a document is responsible for verifying that it is current. To this end the Project has established a number of controls to assist in this determination. The Project has a configuraton management program described in the *Configuration Management Plan (NIF-LLNL-96-070),* which ensures that baseline documents once approved are controlled. The controlled change process for baseline documents is described in *NIF Procedure 1.7 Baseline Change Control* and *6.4 Engineering Change Requests.* The Project Data Management System assists in the implementation of change control. Procedures describing the use of this system are prepared and coordinated by the Systems Integration group.

Subcontractors are required by procurement documents to supply plans and procedures that describe their control of documents and records created as a result of subcontract work.

## 4.2 Procurement Documents

Procurement documents, such as requisitions, purchase orders, statements of work, supplier evaluations, etc., are locally controlled at the Project's Procurement Office until procurements are completed, or controlled at the Project DCC in accordance with NIF Procedure 4.1, cited above. Procurement controls are discussed in Section 7.0.

## 4.3 Quality Records

Records that provide evidence of the quality of structures, systems, components, and activities are maintained during active use by each responsible organization or subcontractor. When records have been completed, they are validated (Q-Level 1 only) and transmitted to the DCC where they are retained according to NIF Procedure 4.1. Reviews and approval of technical records performed by Project personnel are accomplished according to *NIF Procedures 5.1, Title II Design Review, Procedure 6.4, Engineering Change Requests, Procedure 8.3, Preparation and Standard Content for Acceptance Test Procedures* and *Procedure 8.4 Preparation and Standard Content for Operational Test Procedures.*

# PERFORMANCE

## 5.0 Work Processes

Criterion 5 of DOE Order 414.1 requires the following:

- Work shall be performed under controlled conditions according to established technical standards and approved administrative controls.
- Items shall be identified and controlled to ensure their proper use, and maintained to prevent their loss or deterioration.
- Equipment used for monitoring or data collection shall be calibrated and maintained.

### 5.1 Procedures and Other Instructive Documents

Project activities are prescribed by and accomplished in accordance with plans, instructions, procedures, drawings, specifications, or checklists, and with nationally recognized codes and standards appropriate to the assigned tasks. These documents contain appropriate performance standards for the work, such as quantitative and qualitative acceptance criteria for determining that the prescribed activities have been satisfactorily accomplished.

Project activities are also governed by the procedures established in the *Project Control Manua (CD 027).* The procedures in this manual are generated according to a standard format designed to present all the information needed by a user, which is prescribed in *NIF Procedure 1.1, Preparation of PCM Procedures.*

Subcontractor activities are governed by Project-approved procedures and instructions prepared according to their QA Plans unless otherwise noted (see Sections 1.3 and 7.1).

### 5.2 Identification and Control of Items

Processes for the identification and control of documents generated by the NIF Project are prescribed in procedures established in the Project Control Manual. Q-Level 1 hardware and software items (and Q-Level 2 and 3 items specified by the technical authority) produced by the Project are identified and controlled according to plans, procedures, or instructions prepared by the organizations responsible for the hardware or software. Identification of these items is maintained on the items or in documents traceable to them.

Processes for the identification and control of items produced by subcontractors are prescribed in Project-approved procedures that describe methods for ensuring their traceability and for assuring only correct materials are used, including consumables with limited shelf-lives.

### 5.3 Handling, Storage, and Shipping

Handling, storage, labeling, shipping, cleaning, and preservation of Q-Level 1 components (and Q-Level 2 and 3 items specified by the technical authority) are accomplished according to plans, specifications, procedures, or instructions prepared by the organizations responsible for the items. These procedures are designed to prevent damage, loss, or deterioration until installed in the NIF.

### 5.4 Control and Calibration of Measuring and Test Equipment

Control of monitoring, data collection, and test equipment is accomplished according to Project-approved procedures or instructions prepared by the organizations responsible for the items, or according to applicable codes and standards. The instructions or standards describe methods by which gages, tools, instruments, and other equipment used for activities affecting quality are to be calibrated, adjusted, and maintained at specified intervals, and controlled to ensure their accuracy. Equipment of this type that does not require formal calibration is only checked periodically for proper function.

## 6.0 Design

Criterion 6 of DOE Order 414.1 requires the following:

- Items and processes shall be designed using sound engineering and scientific principles, and appropriate standards.
- Design work and design changes shall incorporate applicable requirements and design bases.
- Design interfaces shall be identified and controlled.
- Design adequacy shall be verified and validated by qualified individuals who did not perform the work.
- Verification and validation shall be completed before the design is approved and implemented.

Technical activities of the NIF Project are controlled to a degree commensurate with their Q-Level. Design process controls used by organizations that perform engineering services cover the range of activities from documenting design requirements and calculations through design development, output, changes, records, interfaces, verification, and approval.

### 6.1 Design Preparation and Control

The control processes for design and engineering performed by the NIF Project are prescribed by *NIF Procedures 6.1, Preparation and Revision of System Design Requirements, 6.2, Preparation and Revision of Interface Control Documents,* and *6.3, Engineering Drawing Standards and Controls.* In addition, NIF Procedure 5.1, Title II Design Review describes the process by which in-process and complete designs are verified for compliance with design requirements and readiness for procurement. Organization-specific procedures or instructions may also be used to address individual activity details.

Subcontractors performing design and engineering services are required by procurement documents to provide plans and procedures that describe their design control processes, for acceptance by the Project.

### 6.2 Design Verification

Designs of Project structures, systems, and components are verified by qualified personnel implementing the processes described *NIF Procedure 5.1, Design Review* and *NIF Procedure 6.4, Engineering Change Requests.* Technical records are reviewed by qualified personnel according to *NIF Procedure 8.3, Preparation and Standard Content for Acceptance Test Procedures* and *Procedure 8.4, Preparation and Standard Content for Operational Test Procedures.* The design verification of systems are documented and maintained in the DCC file.

### 6.3 Configuration Management

Project system configurations are controlled by the technical and administrative processes described in the *NIF Configuration Management Plan* (NIF-LLNL-96-070). The Plan invokes a number of interrelated procedures of the PCM, which are operative in managing the Project configuration, particularly *NIF Procedure 1.7 Project Change Control and 6.4, Engineering Change Requests.*

## 7.0 Procurement

Criterion 7 of DOE Order 414.1 requires the following:

- Suppliers shall be evaluated and selected on the basis of specified criteria.
- The Project shall ensure that procured items and services meet established requirements and perform as specified, and that approved suppliers continue to provide acceptable items and services.

All procurement activities for the NIF Project are accomplished according to the University of California Laboratory procurement Policies and Standard Practices. However, certain procurements may be controlled to a greater degree, depending on

the assigned Q-Level. The Project's procurements are planned and monitored through the processes described in *NIF Procedure 7.4, Special Equipment Procurement* and *NIF Procedure 1.10 Procurement Planning and Execution.*

### 7.1 Supplier Use of NIF Project QA Program

Supplier organizations may be described in subtier or ancillary QA plans, as described in Section *1.3 Organization.* In cases where the procurement scope or schedule constraints cannot justify sub-contractor/supplier development or maintenance of a full QA program, the NIF Project organization directing the work may permit some or all of the supplier's activities to be performed under the jurisdiction of this document. Under these circumstances, the responsible Project technical authority shall ensure that procurement documents (including the RFP) specify those portions of this QAPP that apply to the supplier's work. In addition, Project approval of certain supplier work processes may be required. The technical authority shall identify those processes that will require written description from the supplier and approval by the Project (see Section 5.1).

### 7.2 Supplier Qualification

Suppliers of items and services for the Project are evaluated and qualified through the process described in *NIF Procedure 7.1, Supplier Qualification.*

### 7.3 Standard Procurement Practice

The *NIF Project Acquisition Plan (NIF-96-251) and the NIF Special Equipment Procurement Plan, (NIF-2705-OA)* addresses the scope, schedule, and selection of suppliers for the Projects major procurements. All procurement activities are accomplished in accordance with *NIF Procedure 7.2, Standard Procurement Policies and Practices,* which addresses the application of University of California requirements for Project procurements of all types.

### 7.4 Vendor Surveillance

Verification of supplier compliance with quality requirements of Q-Levels 1 and 2 items and services is performed by qualified personnel in accordance with *NIF Procedure 7.3, Vendor Surveillance.* This activity includes source inspections and reviews of suppliers' production and inspection records and other documentation verifying the achievement of quality at the source. Verification of compliance with quality requirements for selected Q-Level 3 components during production may be obtained by vendor certification or other means.

# 8.0 Inspection and Acceptance Testing

Criterion 8 of DOE Order 414.1 requires the following:

- Inspections and tests shall be conducted using established acceptance and performance criteria.
- Equipment used in inspections and tests shall be calibrated and maintained.

## 8.1 Inspection

In-process and acceptance inspections are performed by qualified subcontractor personnel in accordance with Project-approved procedures prepared by the designer or the organization responsible for inspection, or according to the codes and standards that apply to structures, systems, and components inspected. Project personnel witness critical inspections of Q-Level 1 items and selected Q-Level 2 and 3 items when appropriate. NIF QA personnel periodically witness inspections (or may perform inspections) as a part of the surveillance and assessment processes discussed in Sections 7.0 and 10.0.

Optical components to be used in NIF laser systems may receive special inspections as indicated in the *QA Plan for Laser Materials and Optical Technology* (NIF-LLNL-96-276) and its references. Computer software to be used in the control and diagnostics of NIF laser systems receive special inspections as indicated in the *Software QA Plan* (NIF-0000288) and its references.

Receiving inspections at the job site for Q-Level 1 and selected Q-Level 2 and 3 materials and equipment components are performed by either NIF Project personnel or subcontractor personnel according to Project-approved procedures prepared by the designer or the organization responsible for inspection.

## 8.2 Acceptance Testing

Acceptance tests are performed by qualified NIF Project personnel or subcontractor personnel in accordance with Project-approved procedures prepared by the technical authority or the organization responsible for inspection. Guidance for the preparation of acceptance test documents is contained in *NIF Procedure 8.3 Preparation and Standard Content for Acceptance Test Procedures*. Tests are performed and documented according to the codes and standards that apply to structures, systems, and components tested. Project personnel witness acceptance tests of Q-Level 1 items and when appropriate, selected Q-Level 2 and 3 items. NIF QA personnel periodically witness tests as a part of the surveillance and assessment processes discussed in Sections 7.0 and 10.0.

Operational testings is integrated testing of NIF systems. These tests are performed by personnel of the NIF Start-up and Operations organization, or subcontractors.

Guidance for the preparation of operational test documents is contained in *NIF Procedure 8.4 Preparation and Standard Content for Operational Test Procedures.*

## 8.3 Calibration of Measuring and Test Equipment

Control and calibration of monitoring, data collection, and test equipment is accomplished as described in Section 5.0.

# ASSESSMENT

## 9.0 Management Assessment

Criterion 9 of DOE Order 414.1 requires that management at all levels do the following:

- Periodically assess the performance of the integrated quality assurance program (project management system).
- Identify and correct problems that hinder the Project from achieving its objectives.

NIF Project organization managers and supervisors participate in periodic self-assessments conducted by the NIF Project Manager and/or the Associate Project Engineers/Leader, according to the guidance in *NIF Procedure 9.2, Management Self-Assessments.* Managers may independently determine the need to evaluate ongoing activities within their organizations, regardless of other Project assessments. When so determined, internal assessments are conducted using self-assessment plans prepared according to **Procedure 9.2** (What's the title of this procedure??).

Further, a Project Scientist's Advisory Panel, established by the Project Manager in *NIF Procedure 9.1, Charter for the Project Scientist's Advisory Panel,* critically and systematically assesses proposed project changes that could impact achievement of mission objectives.

## 10.0 Independent Assessment

Criterion 10 of DOE Order 414.1 requires the following:

- Planned, periodic, independent assessments shall be conducted to measure item quality, determine process effectiveness, and promote improvement.
- Independent assessors shall be free of the line organization and shall have sufficient authority to carry out their responsibilities.
- Independent assessors shall be technically qualified and knowledgeable in the areas assessed.

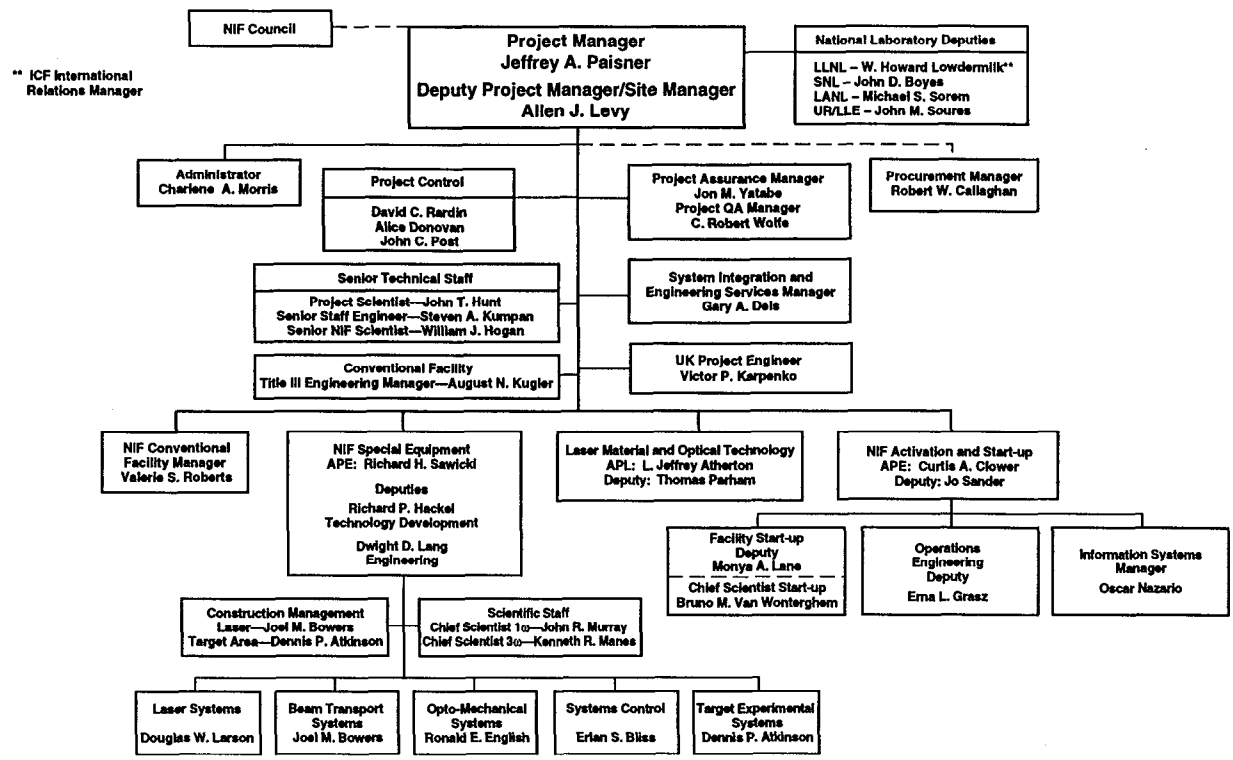
The NIF Project QA organization schedules, plans, and conducts periodic assessments, audits, and other reviews to evaluate the line organizations' achievement of requisite quality objectives. This system of QA oversight is designed to advise management of potential problems and utilizes the technically knowledgeable advisors working with QA evaluators to focus on the effectiveness of the Project's QA Program, its performance, and its results. Independent assessments of Project activities are conducted in accordance with *NIF Procedure 10.1, Independent Assessment* and *NIF Procedure 10.2 QA Surveillance.* Personnel who lead independent QA audit teams are

certified and those who participate on the teams are qualified in accordance with *NIF Procedure 2.3, Qualification of QA Program Auditors.*

There are also assessments performed by outside organizations. For example, Project Quarterly Reviews performed by the Office of Inertial Fusion and the NIF Project in DOE-DP, management system assessments performed by DOE OAK, validation reviews performed by DOE-FM, construction safety reveiws by DOE-DP, Independent Cost Estimate reviews performed by an indepedent contractor (e.g., Foster Wheeler USA).

# Appendix A

## NIF Project Organization—6/98

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# Appendix B
# Glossary of Acronyms and Common Terms

Acronyms

| | |
|---|---|
| AAFEP | automatic alignment front end processor |
| A/E | Architect/Engineer |
| ACE | American Controls Engineering |
| AM | Amplitude Modulation |
| AMPLAB | Amplifier Module Prototype Laboratory |
| ANL | Argonne National Laboratory |
| APE | Associate Project Engineer |
| APL | Associate Program Leader |
| ASE | amplified spontaneous emission |
| ASME | American Society of Mechanical Engineers |
| ATM | asynchronous transfer mode |
| ATP | Acceptance Test Procedure |
| AVLIS-POCO | Atomic Vapor Laser Isotope Separation, Pre-operation Check-out |
| AWE | Atomic Weapons Establishment (British) |
| AWG | arbitrary waveform generator |
| BAC | Budget at Completion |
| BAAQMD | Bay Area Air Quality Management District |
| BCCB | Baseline Change Control Board |
| BCP | Baseline Change Proposal |
| BL | Bottom Loading |
| BSG | Beam Sampling Grating |
| BSM | Beam Shaping Module |
| BTS | Beam Transport Systems |
| CADD | Computer Aided Design and Drafting |
| CAP | Cost Account Plans |
| CAVE | Crystal Alignment and Verification Equipment |
| CCD | charge coupled device (camera) |
| CCI | Cleveland Crystals Incorporated |
| CCRS | chamber center reference system |
| CD | Critical Decision |
| CDR | Conceptual Design Report |
| CF/CM | Conventional Facilities Construction Management |
| CEA | Commissariat à l'Énergie Atomique |
| CEL-V | Centre d'Etude de Limeil – Valenton |
| CFD | computational fluid dynamics |
| CFS | continuous filtration system (for crystal growth tanks) |
| CM | Configuration Management |

| | |
|---|---|
| CM | Construction Management |
| COMS | crystal orientation measurement system |
| CORI | coaxial reference interferometer |
| CORBA | Common Object Request Broker Architecture |
| CP | Continuous Polisher (same as a ring polisher) |
| CPM | Critical Path Method |
| CPU | Central Processing Unit |
| CSF | cavity spatial filter |
| CSG | color separation grating |
| CS&T | Core Science and Technology |
| CTR | Contingency Transfer Request |
| DAS | data acquisition system |
| DCO | directed change order |
| DFM | deformable mirror |
| DFM | diamond flycutting machine |
| DIM | diagnostic instrument manipulator |
| DKDP | deuterated potassium dihydrogen phosphate |
| DM | deformable mirror |
| DMS | damage mapping system |
| DOE | Department of Energy |
| DOE/DP | Department of Energy – Defense Programs |
| DOE/GC | Department of Energy – General Council |
| DOE/HQ | Department of Energy – Headquarters |
| DOE/FM | Department of Energy – Field Management |
| DOE/OAK | Department of Energy – Oakland Operations Office |
| DOE/RFP | Department of Energy – Rocky Flats Plant |
| DOI | Department of Interior |
| DOJ | Department of Justice |
| DOP | diffractive optics plate |
| DP | Defense Programs |
| EAC | estimate at complete |
| ECR | Engineering Change Request |
| EMI | electromagnetic interference |
| EPD | Environmental Protection Department |
| EPS | Environmental Protection System |
| ERD | Environmental Restoration Division |
| ES&H | environmental, safety, and health |
| FAR | Federal Acquisition Regulations |
| FAU | frame assembly unit |
| FDDI | fiber distributed data interface |
| FEA | finite element analysis |
| FEP | Front End Processor |
| FL | focus lens |
| FM | Frequency Modulation |
| FMEA | failure mode and effect analysis |
| FOA | final optics assembly |

| | |
|---|---|
| FOC | final optics chamber |
| FOC | final optics cell |
| FPEIS | Final Programmatic Environmental Impact Statement |
| FSC | Federal Supply Classification |
| FSAR | Final Safety Analysis Report |
| FTE | full time equivalent |
| GB | GigaByte |
| GFE | government furnished equipment |
| GUI | graphical user interface |
| HDOS | Hughes Danbury Optical Systems |
| HVAC | heating, ventilation and air conditioning |
| ICCS | Integrated Computer Control System |
| ICD | Interface Control Document |
| ICF | Inertial Confinement Fusion |
| ICE | independent cost estimate |
| IHS | information handling systems |
| IOM | integrated optics module |
| IPS | integrated project schedule |
| IRP | integrated resource planning |
| ISP | input sensor package |
| ISS | Integrated Safety System |
| ITS | integrated timing system |
| IWO | Integrated Work Order |
| JPL | Jet Propulsion Laboratory |
| KD*P | Deuterated Potassium Dihydrogen Phosphate |
| KDP | Potassium Dihydrogen Phosphate |
| LADS | large aperture diagnostic system |
| LANL | Los Alamos National Laboratory |
| LB | Laser Bay |
| LBTS | Laser Bay Transporter System |
| LE | Lead Engineer |
| LGDT | laser glass damage tester |
| LGIS | laser glass inspection system |
| LIL | Laser Integration Laboratory (France) |
| LLNL | Lawrence Livermore National Laboratory |
| LM | Laser Mirror |
| LMJ | Laser MegaJoule (France) |
| LODI | Large Optic Damage Inspection (System) |
| LRU | line replaceable unit |
| LSED | Laser Science and Engineering Division (LLNL Mechanical Engineering Department) |
| LTAB | Laser and Target Area Building |
| MA | Main Amplifier |
| MAP | Mitigation Action Plan |
| MCC | Monroe Community College (Rochester, NY) |
| MDMS | Metrology Data Management System |

| | |
|---|---|
| MEITO | Mechanical Engineering Internal Transfer Opportunities |
| MOR | master oscillator room |
| MPA | multi-pass amplifier |
| MRP | manufacturing resource planning |
| MTA | Master Task Agreement |
| MTV | maintenance transport vehicle |
| NAS | National Academy of Sciences |
| NAVOO | Nevada Operations Office |
| NCR | nonconformance report |
| NIF | National Ignition Facility |
| NRL | Naval Research Laboratory |
| NS | Neutron Spectrometer |
| NTP | Notice to Proceed |
| NTS | Nevada Test Site |
| OAB | Optical Assembly Building |
| OCIP | Owner-Controlled Insurance Program |
| OCA | Optical Corporation of America |
| OCLI | Optical Coating Laboratory Inc. |
| OPC | other project costs |
| OPG | optical pulse generation |
| OPEX | operating expenses |
| OS | output sensor |
| OSHA | Occupationl Safety and Health Authority |
| OSL | Optical Sciences Laser |
| OSP | Operational Safety Procedure |
| OSS | Optical Support Structure |
| OTP | Operational Test Procedure |
| P&ID | piping and instrumentation diagram |
| PA | Power Amplifier |
| PABTS | pre-amplifier beam transport system |
| PACE | plant and capital equipment |
| PAM | pre-amplifier module |
| PAMMA | pre-amplifier module maintenance area |
| PASS | pre-amplifier support structure |
| PCC | Precision Components Corporation |
| PC/FR | Primary Criteria and Functional Requirements |
| PCU | power conditioning unit |
| PCS | power conditioning system |
| PDM | product data management |
| PDM | Pitt-Des Moines Steel |
| PDS | product data structure |
| PEIS | Programmatic Environmental Impact Statement |
| PEPC | plasma electrode Pockels cell |
| PETG | plastic material used for optical storage containers |
| PFN | pulse forming network |
| PHOM | Phase Homogeneity (a method of homogeneity testing) |

| | |
|---|---|
| PI | Physics International Corp. |
| PLA | Project Labor Agreement |
| PLC | Programmable Logic Controller |
| PMP | Process Materials and Procedures |
| PSAR | Preliminary Safety Analysis Report |
| PSD | power spectral density |
| QA | quality assurance |
| QAPP | Quality Assurance Program Plan |
| QC | Quality Control |
| QCM | Quality Manager for Construction |
| R&D | research and development |
| RAM | random access memory |
| RAM | reliability, availability, and maintainability |
| RBD | reliability block diagram |
| RFI | Request for Information |
| RFP | Request for Proposal |
| RFQ | Request for Quote |
| RMDA | roving mirror and diagnostic assemblies |
| ROD | Record of Decision |
| ROSI | Raytheon Optical Systems Incorporated |
| RP | Ring Polisher |
| RPOM | roving pick-off mirror |
| RTNS | Rotating Target Neutron Source |
| SAGEM | (a French optical company) |
| SBS | stimulated Brillouin scattering |
| SDR | System Design Requirements |
| SEC | Software Engineering Computer |
| SEG | Special Equipment Group |
| SF | spatial filter |
| SGT | Schott Glass Technologies, Inc. |
| SI | System Integration |
| SLAC | Stanford Linear Accelerator Center |
| SLM | spatial light modulator |
| SME | Safety Management Evaluation |
| SMIF | Standard Mechanical Interface |
| SNL | Sandia National Laboratories |
| SNL-Alb. | Sandia National Laboratory, Albuquerque |
| SOLID | Schlieren (On-line Imaging of Damage) |
| SOW | Statement of Work |
| SRS | Software Requirement Specification |
| SSC | systems, structures and/or components |
| SSD | smoothing by spectral dispersion |
| SSDR | Sub-system Design Requirements |
| SSH | security shell |
| SSMP | Stockpile Stewardship and Management Program |
| SW | Switch Window |

| | |
|---|---|
| SWPPP | Storm Water Pollution Prevention Plan |
| SY | switchyard |
| TAB | Target Area building |
| TA DAS | Target Area data acquisition system |
| TAS | target alignment sensor |
| T&H | transport and handling |
| TBD | to be determined |
| TCSS | target chamber service system |
| TCVW | Targt Chamber Vacuum Window |
| TEC | total estimated cost |
| TMP | Technical Management Plan |
| TL | Top Loading |
| TOPS | Total Operating Procurement System |
| TSF | transport spatial filter |
| TTC | ThermoTrex Corporation |
| UBC | Uniform Building Code |
| UCMP | University of California Museum of Paleontology |
| ULOLT | Universal Large Optics Lifting Tool |
| ULPA | Ultra Low Particle Air (filter) |
| UR/LLE | University of Rochester, Laboratory for Laser Energetics |
| UV | Ultraviolet (light) |
| VOC | volatile organic compounds |
| VIV | vacuum isolation valve |
| VME | Versa Module Europe |
| WBS | work breakdown structure |
| WPA | work package agreement |

**Definitions of Common Terms**

**Assessment/Verification**—The act of reviewing, inspecting, testing, checking, conducting surveillances, auditing, or otherwise determining which items, process, or services meet specified requirements.

**Configuration**—The Project technical baseline as identified in documents formally designated and approved by the NIF Project Office and DOE. The physical and functional description of a facility, structure, system, or component.

**Configuration Management**—The systematic evaluation, coordination, approval, documentation, implementation, and verification of approved changes to the NIF Project configuration (technical baseline) after having formally identified the baseline.

**Corrective Action**—Measures taken to rectify conditions adverse to quality and, where necessary, to prevent recurrence.

**Design Verification**—The act of verifying the adequacy of design through the use of design review, alternate calculations, or qualification testing.

**Document**—Recorded information that describes, defines, specifies, reports, certifies, requires, or provides data or results. A document is not considered a record until it is complete.

**Graded Approach**—The method of allocating the rigor of quality assurance efforts to individual Project activities or elements. It is based on an assessment of the consequences associated with the potential failure of activities or elements.

**Item**—An all-inclusive term used in place of any of the following: appurtenance, facility, sample, assembly, component, equipment, material, module, part, structure, subassembly, subsystem, system, unit, documented concepts, or data.

**Nonconformance**—A deficiency in characteristic, documentation, or procedure that renders the quality of an item of hardware, software, or an activity unacceptable or indeterminate.

**Quality**—The degree to which an item or process meets or exceeds the end user's requirements and expectations.

**Quality Assurance**—Actions that provide confidence that quality is achieved.

**Quality Assurance Level (Q-Level)**—A designation applied to Project elements based on risks in the event of failure. It denotes the level of confidence necessary, and the amount of formal quality assurance action required to substantiate the work performed.

**Record**—A completed document or other media that specifies requirements for or provides objective evidence of the quality of an item or process.

**Work**—Process of performing a defined task or activity, such as research and development, engineering design, component fabrication, operations, maintenance and repair, administration, software development and use, construction, inspection, data collection, analysis, etc.

**Work Breakdown Structure (WBS)**—A hierarchical organization of activities that describes and establishes relationships between the work elements of the project. The WBS assigns a number to each major category of work or component.

# Appendix C
# QA Program Implementing Documents

| QA Program Criteria | NIF Project Implementing Documents |
|---|---|
| **1.0 Program** | |
| Program Management | • This Project QAPP, Section 1.0<br>• NIF Project Management System Description (NIF-0002216)<br>• Project Execution Plan, CD 079 |
| Grading (Q-Levels) | • Procedure 1.6, Assignment of Q-Levels |
| Organization | • This QAPP (Appendix A)<br>• NIF Management Descriptions (NIF-0000810) |
| Stop Work Authority | • Procedure 3.3, Stop Work Action |
| Cost and Schedule Control | • Procedure 1.2, Cost Estimating<br>• Procedure 1.9, Generation of Cost Account Plans<br>• Procedure 1.3, Schedule Preparation, Statusing and Revision<br>• Procedure 1.10, Procurement Planning and Execution<br>• Procedure 1.7, Project Change Control |
| **2.0 Training and Qualification** | |
| Personnel Performing Work | • Procedure 2.1, Personnel Qualification & Approval<br>• Procedure 2.2, Personnel Orientation & Training |
| Personnel Verifying Work | • Procedure 2.3, Qualification of QA Program Auditors |
| **3.0 Quality Improvement** | |
| Nonconformance Control | • Procedure 3.2, Nonconformance Reporting |
| Corrective Action Tracking | • Procedure 1.8, Project Action Tracking System |
| **4.0 Documents & Records** | |
| Technical Documents, Quality Records | • Procedure 4.1, Document & Records Control<br>• Procedure 4.2, Control of Project Correspondence |
| Procurement Documents | • Procedure 7.2, Standard Procurement Policies & Practice |

| QA Program Criteria | NIF Project Implementing Documents |
|---|---|
| **5.0 Work Processes** | |
| Instruction, Procedures, Drawings | • Project Control Manual, CD 027<br>• Procedure 1.1, Preparation of Procedures<br>• Procedure 5.1, Title II Design Review<br>• Preparation of Addenda to the Preliminary Safety Analysis Report (PSAR)<br>• Procedure 8.3, Preparation and Standard Content for Acceptance Test Procedures |
| Identification & Control of Items | • Project-approved procedures by sub-contractors or other subtier Project organizations; |
| Handling, Storage & Shipping | • Procedure 8.2, Standard Content for Specifications<br>• Project-approved procedures by sub-contractors or other subtier Project organizations |
| Control of Measuring and Test Equipment | • Project-approved procedures by sub-contractors or other subtier Project organizations |
| **6.0 Design** | |
| Design Preparation and Control | • Procedure 6.1, Preparation and Revision of System Design Requirements<br>• Procedure 6.2, Preparation and Revision of Interface Control Documents<br>• Procedure 6.3, Engineering Drawing Standards and Controls Standards & Controls<br>• Procedure 5.1, Design Review<br>• Procedure 6.4, Engineering Change Requests<br>• Procedure 6.5, Preparation of Primary Criteria and Functional Requirements<br>• Title III Change Control |
| Design Verification | • Procedure 8.3, Preparation and Standard Content for Acceptance Test Procedures<br>• Procedure 8.4, Preparation and Standard Content for Operational Test Procedures<br>• Title III Engineering Plan |
| Configuration Management | • NIF Configuration Management Plan (NIF 96-070)<br>• Project Data Management System (PDMS) procedures |

| QA Program Criteria | NIF Project Implementing Documents |
|---|---|
| **7.0 Procurement** | |
| Supplier Use of NIF QAPP | • this Project QAPP, sections 1.3, 5.1 and 7.1 (NIF-0000618) |
| Supplier Qualification | • Procedure 7.1, Supplier Qualification |
| Standard Procurement Practice | • Procedure 7.2, Standard Procurement Policies and Practices<br>• Procedure 7.4, Special Equipment Procurement<br>• Procedure 1.10, Procurement Planning and Execution |
| Vendor Surveillance | • Procedure 7.3, Vendor Surveillance |
| **8.0 Inspection and Testing** | |
| Inspection | • Laser Materials & Optical Technology QA Plan (NIF-LLNL-96-276)<br>• Software QA Plan (NIF-0000288)<br>• Project-approved procedures by subcontractors or other subtier Project organizations |
| Acceptance Testing | • Procedure 8.2, Standard Content for Specifications<br>• Procedure 8.3, Preparation and Standard Content for Acceptance test Procedures |
| Operational Testing | • Procedures 8.4, Preparation and Standard Content for Operational Test Procedures |
| Control of Measurement and Test Equipment | • Project-approved procedures by sub-contractors or other subtier Project organizations |
| **9.0 Management Assessment** | |
| Technical Objectives | • Procedure 9.1, Charter for Project Scientist's Advisory Panel<br>• Procedure 9.2, Management Self-Assessments |
| Project Organizations | • Procedure 5.1, Design Review<br>• Project Execution Plan, CD 079 |
| **10.0 Independent Assessment** | |
| QA Oversight and Audits | • Procedure 10.1, Independent Assessments<br>• Procedure 10.2, Quality Assurance Surveillance |
| Auditor Qualification | • Procedure 2.3, Qualification of QA Program Auditors |

# Appendix D
# NIF Project Lessons Learned

The section headings of these Lessons Learned refer to related topics described in the Project Execution Plan (UCRL-ID-126525 Rev 1):

## 1. Establish Critical Agreements:

a. Prior to Project start:
- Memorandum of Agreement between major participants (development of teamwork and communication among the participants).
- Overhead rates with each major participating institutions.
- NEPA strategy and schedule for the Project with the DOE.

b. Prior to start of construction:
- Project Labor Agreement with labor unions representing building trades.

## 2. Roles and Responsibilities

a. Discuss with other Projects of a similar nature and magnitude (e.g., CEBAF), their approach, and their lessons learned. NIF visited three major DOE strategic initiatives prior to starting the CDR.

b. Establish protocols (e.g., points-of-contact, etc.) for working with the DOE Field Offices and DOE HQ. Assign a Project representative at DOE HQ to assist and to ensure a solid communication network for normal and emergency issues.

c. In the Conceptual Design Phase, the most important first hires are:
- Project Manager
- Project Control Manager
- Senior Scheduler
- Assurance Manager
- Conventional Facilities Manager

## 3. Project Execution

a. The Project Execution Plan defines all of the major responsibilities, key administration processes, and baselines. It must be prepared early in the Project (e.g., after CDR) and maintained current throughout the Project.

b. Establish technical and cost and schedule baselines and a control process through tiered Change Control Boards.
- Develop the technical criteria from the top (Primary Criteria—DOE HQ controlled) down through detailed subsystem design criteria. Ensure that flowdown of the criteria is fully documented; be aware of DOE and each institution's position on Work Smart Standards. Design must be rigidly focused on meeting these requirements. Changes or additions to the requirements must be strictly controlled.

- Select a cost and schedule estimating and tracking tool(s) to form and maintain these basic elements of the Project baseline. These tools must be established early in the Project and used consistently to control these key baselines.

c. If there is a Technology Program interface, get that interface under control. This may be a complex and generally difficult undertaking. The Project must be fiscally responsible for development work related to its success.

d. Work closely with the Procurement organization to emphasize procurement planning. Expert technical design organizations may be poor at this. The key procurements are:

- First, the AE selection (can change after CDR); key to getting to next level. (The AE must be good at understanding complex technology, cost estimating, analysis for difficult issues, such as clean rooms and scheduling.).
- Conventional Facility (construction packages developed by AE).
- Optics procurement, especially preproduction work such as optics facilitization—getting vendor capability to produce high quality and quantity of optics.
- Special Equipment procurement—all nonconventional facility equipment.
- The NEPA document preparer, a DOE contract—key to meeting schedule.

e. Document work processes of wide use on the Project via written procedures and enforce adherence (top down). Revise as conditions dictate. This will encourage a disciplined Project culture that works via written rather than oral direction. This culture will prove valuable when line organizations begin preparing their own written work instructions.

f. Make a list of the top risks for the Project and develop a risk management plan and methodology, including mitigative measures and their cost.

## 4. Method of Accomplishment

a. The early definition of the Hazards Category of the facility is essential design input. A Preliminary Hazards Analysis concurred with by the DOE Field Office needs to be prepared at ~1/3 of the way through the CDR preparation. If the hazards category is 1, 2, or 3, significant revision to criteria and design features may be required.

b. Prepare Conceptual Design Title I, Title II, and Title II Plans with a statusable schedule to control the activity. For NIF, DOE actively participated, but it can also be controlled at the contractor level. Project deliverables (designs, plans, documentation, hardware) must be clearly defined for each Project phase. Completion dates for those deliverables must be established with clear vision as to when they are needed. This will help to assure the optimum ramp-up/down of personnel.

c. Interface control documentation must be completed as soon as possible in the Project, preferably complete at Title I design review. Design effort must not proceed without this documentation being established.

d. Configuration control infrastructure must be clearly established early in the Project and strongly/visibly supported by Project Management.

e. Design review process must be carefully balanced to assure both objective external review and comprehensive internal checks and balances. The number and timing of the reviews should accent the work being done, not hinder its progress.